Application Serial No: 10/790,339
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Amendments to the Specification:

Please replace paragraph [0023] on page 4 with the following rewritten paragraph:

--[0023] ~~FIG. 10 shows~~ FIGS. 10a-b show an embodiment of the present invention where the dielectric layer is enclosed with conductive polysilicon; and--

Please replace paragraph [0023] on page 4 with the following rewritten paragraph:

--[0041] Alternatively, a conductive layer is deposited before the dielectric layer 50 is deposited so that the cantilever 20 is completely enclosed by conductive polysilicon. ~~FIG. 10 shows~~ FIGS. 10a-b show a cross sectional view of a cantilever completely enclosed by polysilicon.--

[0015] Fig. 2 shows an alternative embodiment having both top and bottom conductive layers;

[0016] Fig. 3 shows a cantilever and a conductive pad for electrostatic actuation of the cantilever;

[0017] Fig. 4 shows a cantilever with a conductive layer on the top surface;

[0018] Figs. 5a-5e illustrate a preferred method for making the present invention;

[0019] Fig. 6 shows an alternative embodiment with a conductive layer disposed within the dielectric layer;

[0020] Fig. 7 shows an alternative embodiment of the present invention having vias for electrically connecting top and bottom conductive layers;

[0021] Fig. 8 shows a cross sectional view of a cantilever of the present invention having a conductive layer on the top surface and sidewalls;

[0022] Figs. 9a-9f illustrate a method for making the cantilever shown in Fig. 8;

[0023] Fig. 10 shows an embodiment of the present invention where the dielectric layer is enclosed with conductive polysilicon; and

[0024] Fig. 11 shows a particularly useful application of the present invention for a microelectrooptomechanical variable reflector.

Detailed Description of the Invention

[0025] The present invention provides released microstructures having a dielectric layer, such as silicon nitride or silicon carbide, combined with a much thinner layer (e.g., 1/5, 1/10, 1/50 or 1/100 the thickness of the dielectric layer) of a conductive material, such as a metal or polysilicon. The thin conductive layer can be located on the top side and/or bottom side of the dielectric layer, or within the dielectric layer. The relatively thick dielectric layer provides good mechanical properties for the microstructure (e.g., high strength, low internal stress, high rigidity). The conductive layer is sufficiently thin so that it does not adversely affect the mechanical properties of the microstructure. The thin conductive layer provides electrical conductivity so that the microstructure can be used in electrostatic actuators, piezoresistive devices and other microelectromechanical systems (MEMS), or micro-electro-opto-mechanical devices. Preferably, the conductive

Microstructures Comprising a Dielectric Layer and a Thin Conductive Layer

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Related Applications

[0001] This application is a continuation-in-part application of U.S. Application No. 09/541,394, filed March 31, 2000, now Patent No. 6,698,295, the entire contents of which are incorporated herein by reference.

Field of the Invention

[0002] The present invention relates to micromachined structures. More specifically, the present invention relates to released, flexing, and/or suspended multilayer microstructures having a first layer of a structural dielectric material (e.g. silicon nitride) to provide structural support for the released/suspended layer and second layer of an electrically conductive material (e.g. doped polysilicon) disposed over the first layer.

Background of the Invention

[0003] Released microstructures are commonly used in a variety of sensors, actuators and other useful devices. Released microstructures are suspended above a substrate (e.g. silicon) to which they are usually attached or anchored. Examples of released microstructures include comb drives, cantilevers, beams, membranes, switches, electrostatic motors and a wide variety of sensors (e.g. pressure sensors, magnetic sensors).

[0004] Released microstructures are often made from polysilicon. This is because polysilicon can be conformally deposited on many surfaces and it can be doped to provide conductivity. Also, polysilicon is easily released because there are a number of supporting materials available that can be selectively etched from under or surrounding a polysilicon layer (e.g. phosphosilicate glass, PSG). However, polysilicon has the great disadvantage that deposited polysilicon layers can have relatively high internal stress. Therefore, polysilicon structures tend to distort and bend when released. The tendency of polysilicon to bend after release is undesirable for making precision micromachined structures. Another disadvantage of polysilicon is that it can have a relatively low